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Review

A Multi-Actor Literature Review on Alternative and Sustainable Food Systems for the Promotion of Cereal Biodiversity

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Abstract: Organic and low-input food systems are emerging worldwide in answer to the sustainability crisis of the conventional agri-food sector. "Alternative" systems are based on local, decentralized approaches to production and processing, regarding quality and health, and short supply-chains for products with strong local identities. Diversity is deeply embedded in these food systems, from the agrobiodiversity grown in farmers' fields, which improves resilience and adaptation, to diverse

approaches, contexts and actors in food manufacturing and marketing. Diversity thus becomes a cross-sectoral issue which acknowledges consumers' demand for healthy products. In the framework of the European project "CERERE, CEreal REnaissance in Rural Europe: embedding diversity in organic and low-input food systems", the paper aims at reviewing recent research on alternative and sustainable food systems by adopting an innovative and participatory multi-actor approach; this has involved ten practitioners and twenty-two researchers from across Europe and a variety of technical backgrounds in the paper and analysis stages. The participatory approach is the main innovation and distinctive feature of this literature review. Partners selected indeed what they perceived as most relevant in order to facilitate a transition towards more sustainable and diversity based cereal systems and food chains. This includes issues related to alternative food networks, formal and informal institutional settings, grass root initiatives, consumer involvement and, finally, knowledge exchange and sustainability. The review provides an overview of recent research that is relevant to CERERE partners as well as to anyone interested in alternative and sustainable food systems. The main objective of this paper was indeed to present a narrative of studies, which can form the foundation for future applied research to promote alternative methods of cereal production in Europe.

Keywords: sustainable agriculture; low-input farming; safe and healthy diet; locally based agriculture; low-input cereal supply-chains

1. Introduction

Organic and other low-input food systems in Europe are emerging as an innovative answer to the crisis of conventional agri-food value chains, which no longer seem to best serve the public interest because of increased price volatility and negative environmental impacts [1]. To guarantee the development of these low-input systems and to improve their resilience in face of environmental constraints, the embedding of diversity at all stages of the food system could be considered of paramount importance. Specifically, the renewed use of agricultural biodiversity (hereafter also "agrobiodiversity"), and the development of food systems based on short supply-chains, are a cornerstone for all sustainability-oriented agricultural approaches [2,3]. The adoption of new approaches and ideas, aimed at an agricultural revitalization through more sustainable production practices is further stimulated by an increasing consumer demand for healthy and environmentally friendly food products. The rethinking of food systems from an agrobiodiversity standpoint leads to bottom-up innovation from seed to fork [4–6]. Such innovation, in the agricultural phase, has its basis in the reintroduction of in-farm genetic diversity and the development of participatory research approaches (e.g., participatory plant breeding), which enhance a more dynamic and creative use of crop diversity [7–9]. However, new ideas and methods are also developed in other stages of the supply-chain, through the recovering of traditional, artisanal food making practices and the creation of inter-actor relationships based on trust and collaboration [10–13]. Thus, using a supply-chain perspective, farmers seek crops and varieties which are not only fine-tuned to the environment in which they are grown, but which also respond to the preferences of other stakeholders in their local socio-economic networks [9–12]. These result in greater attention paid to certain traits, such as ease of processing with artisanal methods, improved taste, cooking and nutritional qualities, and connection to traditional cultures and local identities. Participatory, multi-stakeholder approaches to research and innovation have thus become more important in this context, inviting farmers, farm advisers, value chain actors and scientists to get involved in a process of active knowledge construction, rather than in a passive technology transfer [8,13–15], through the search for locally relevant solutions based on a more dynamic use of crop diversity [16–22].

Interesting examples of participatory, multi-actor innovation processes aimed at reshaping agricultural and food systems based on agrobiodiversity, decentralization, participation and Short

Food Supply-chains (SFSCs) are currently taking place in European cereal food system [18,23]. Cereals, indeed, are of great importance in European agriculture, accounting for one-quarter of the EU's crop production and for one-eighth of the total value of agricultural products. Organic cereals were grown, in 2016, on approximately 1.9 million hectares, i.e., only around 2.5% of the total EU28 cereal area [24]. An outstanding variety of breads, baked goods, and pasta made with different cereal species are staples of many, if not all, European food cultures. Although conventional varieties of soft and durum wheat are the most produced and consumed among cereals, health concerns, such as those related to increasing awareness to adverse effects of gluten and to other food-related disorders, are triggering a growing demand for healthier and more wholesome cereal foods. Research suggests that this demand can be satisfied by gradually introducing a number of changes in the cereal food chain, from breeding for crop varieties focusing also on nutritional quality and balance, to applying more sustainable agronomic techniques, or using more artisanal rather than industrial processing methods (e.g., sourdough vs yeast, slow drying vs fast drying pasta), and to constructing local and transparent production processes [25–28].

In this context, many pioneering farmers are already engaged in alternative and sustainable farming practices in a number of countries. They are becoming increasingly aware of the importance of having access to germplasm that is more adapted to their specific conditions, than the commercial varieties available on the market and developed mainly under conditions of high-input, intensive agricultural models [7]. Supported by proactive researchers and seed networks, these farmers are experimenting with growing landraces, varieties of ancient grains, as well as varietal mixtures and evolutionary populations [29].

This research was carried out as part of the European Horizon 2020 thematic network "CERERE, CEreal REnaissance in Rural Europe: embedding diversity in organic and low-input food systems". The purpose of this paper is to review recent research on alternative food systems which can be used to foster cereal biodiversity. We followed an innovative participatory approach that involved academics as well as practitioners according to the European Union "multi-actor approach" guidelines. This means that partners with complementary types of knowledge (scientific, practical and others) join forces in the project activities from beginning to end. In this framework, the novelty of this review lies specifically in the participatory approach itself. The paper highlights a variety of issues related to the broad theme of sustainable transition, a change towards a more sustainable socio-technological regime of production which is facilitated by an active involvement of societies, communities and institutions [30]. This is a direct result of a participatory literature review method, aimed at fostering innovation, agrobiodiversity conservation and management with strong involvement of farmer networks working with researchers towards common goals. Therefore, consortium partners selected what they perceived as most relevant in order to facilitate, from a practical point of view, a transition towards more sustainable and diversity based cereal systems and food chains. This includes issues related to alternative food networks, formal and informal institutional setting especially focusing on seed, grass root initiatives and networks themselves, consumer involvement and, finally, knowledge exchange and sustainability. As a consequence, the results of the participatory review are not to be considered as a final goal, but they will be coupled, at a later stage of the project, with real supply-chain case studies to gain useful insights into the development and the functioning of such processes.

The paper begins by presenting the methods applied (Section 2). The next section is concerned with the screening of the literature. The content analysis of the selected papers is presented in Section 4. In Section 5, implications for policy are drawn, and Section 6 reports on the discussion and conclusions.

2. Methods

2.1. The CERERE Project

CERERE is a three-year thematic network project running from 2016 to 2019. It involves a consortium of 13 partners that forms a balance between participants with a scientific and technological

outlook, practitioners including all actors of cereal food systems (from farm to fork) interested in agrobiodiversity, organisations engaged in extension, advisory services, training and communication activities as well as participants who have a focus on rural studies and participatory approaches. Partners belong to universities, research institutes, agricultural and food authorities, advisory centres, networks of farmers, citizens and rural actors from nine European Countries (Denmark, France, Finland, Hungary, Ireland, Italy, Spain, and the UK). The aim of the project is to sustain and promote innovative approaches emerging in Europe from a multitude of practices adopted to introduce and manage agrobiodiversity in cereal production. Due to the large scope of the project, three different focus areas were identified, and a specific literature review was performed for each. This paper covers the "Alternative and sustainable food systems" focus area, while two other papers are dedicated to "Health and nutrition" [31] and "Agronomy and Food Processing".

2.2. Keyword Selection/Identification

In a first phase of collective and participatory discussion, each partner was asked to identify several potential keywords related to the specific focus area (i.e., alternative/sustainable food system). Due to the high number of collected words, they were grouped and assigned to a cluster, with a reference keyword used to summarize the concepts included in the cluster.

Reference keywords were used to build the search strings. Every search string was made up of four parts targeting the topics of general interest for the project (i.e., cereal systems issues), identifying the specific focus area (i.e., sustainable food systems, alternative food systems, rural development etc.), and including the keywords obtained from the participatory process (Appendix A). An example of a search string is displayed below, where the AND operator connects the string parts one another.

> *(wheat OR rye OR spelt OR barley OR bread OR pasta) AND (varieties OR landraces OR "traditional varieties" OR "heritage varieties" OR populations) AND (social OR economics OR "rural development") AND (empowerment OR identity OR re-settlement)*

An exception to this search strategy was made for four strings. The concepts embodied in the reference keywords "alternative food networks", "short supply-chain", "seed network" and "local knowledge" were identified as useful for the project even when addressed by studies not directly involving cereal systems. Therefore, when these keywords were used, we replaced the first two parts of the standard string with the more general keyword "agriculture".

2.3. Paper Filtering Process

An early list of publications suitable for inclusion in the review has been selected from:

- Bibliographic databases (using the previously described search strings): Scopus, Web of Science, Agris, Medline, CAB;
- References quoted in the project proposal;
- Grey literature (EU projects) quoted in the project proposal.

Each retrieved reference entered the screening process, consisting of three steps:

(1) *Eligibility screening* (Appendix B): The initial eligibility of studies was determined looking at easily identifiable features such as year of publication, language or geographical coverage. Specifically, a paper was discarded if it was not written in English, French or Spanish, or if it was written before 2000. Books and book chapters were included. Only eligible studies of the present criteria were further processed. During this screening phase, each paper, according to the topic(s) covered, was assigned to one or more pre-determined content categories.

(2) *Methodological screening*: This screening addressed the scientific quality of papers, such whether the methodology is appropriate to reach the stated objective, the soundness of the experimental design etc. Reviewers assessed the compliance of each study with specific criteria answering

YES/NO questions and assigning a score to several statements using a 1–5 Likert scale (5 indicating a perfect compliance of the study with the statement). Criteria differed for qualitative studies (Appendix C) and quantitative studies (Appendix D).

(3) *Relevance screening*: This screening, distinctive to the CERERE project, is an innovation in literature review. Drawing on the mix of academic and practical expertise in the CERERE Consortium the studies were checked according to whether they dealt with one of the three groups of practical issues (i.e., innovative ways of including diversity at farm level, processing raw materials other than conventional, creating new markets). As in the methodological screening, the evaluation was made using a 1–5 Likert scale score for both the "Practical implication" and the "Overall relevance" sections (Appendix E).

Methodological and relevance screenings, simultaneously conducted, determined the acceptance (or the rejection) of a paper for the review. The acceptance process is summarized in Figure 1.

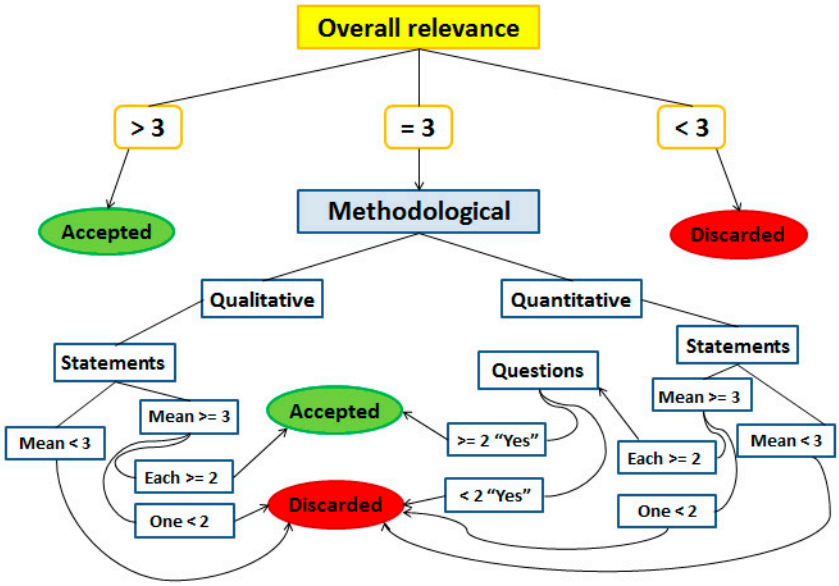

Figure 1. Graphic of the acceptance process of the papers.

The score received for the "Overall relevance" field in the relevance screening form (see Appendix E) was the first criterion used for the inclusion/exclusion of a study. The threshold was set at the median value (i.e., 3). Papers receiving a higher score were included, and those receiving a lower score were discarded. For studies receiving a score of three the methodological screening results were considered. Specifically, qualitative studies, whose assessment was based entirely on statements (see Appendix C), were accepted if the mean score received for statements was not lower than 3 and they didn't receive a score lower than 2 for any statement. The same rule was applied to quantitative studies. These studies, however, had to satisfy a criterion based on questions in addition to statements, and receive at least two "Yes" answers to these questions (Appendix D).

2.4. Content Analysis

Once the rules detailed above provided the final list of papers to review, we carried out a content analysis.

The analysis was divided into two different steps; (1) the main topics were identified for each paper, and (2) similar topics from different papers were grouped in clusters representing broader "research areas". The first step was performed by various academic partners, while the clusters were discussed with all partners (both academic and non-academic).

Each of the academic partners involved in the content analysis was provided with a share of 20 papers. Some papers were assigned to more than one person as a "quality" check to assess

the conformity of the content analysis between different reviewers (for further details on the inter-coder-reliability see Appendix F, Tables A1 and A2). In performing the analysis each reviewer was asked to identify the main topics (up to three for each paper) covered by the study. There were no pre-determined topics, but each reviewer was supposed to identify and name them in the way he/she deemed the most accurate.

The reviewer was also required to produce a text form for each of the assigned papers. The form had to contain the following information:

- Paper references (title, authors, ID);
- Identified topics;
- A brief description for each topic.

Appendix G shown an example of the final structure of the text form.

3. Screening Process Results

The search in bibliographic databases produced 1618 records, 239 of which were considered suitable for a first screening to examine the titles. This number was reduced to 137 records after the eligibility screening (Appendix B) and finally to 98 entries after the methodological and relevance screenings (Appendices C–E), including additional material suggested by partners.

Exploring the change over time in the number of published papers per year (Figure 2) highlights a clearly growing trend, with a marked increase from 2012 onwards. This overall trend was maintained during the selection process and supports our decision to focus only on recent studies (from 2000 onwards).

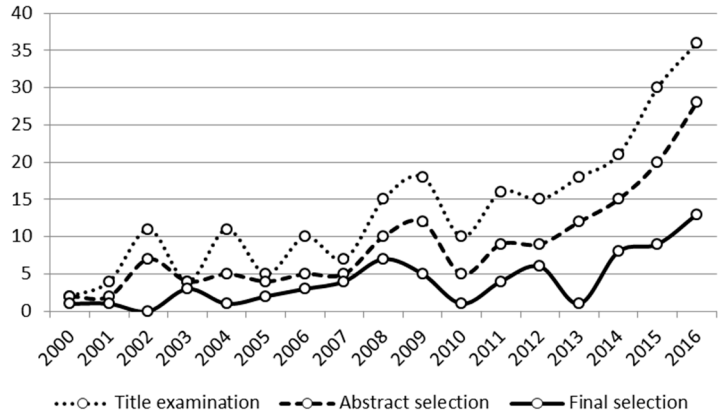

Figure 2. Number of published papers per year at different review process stage.

To get a first overview of the content of the reviewed studies, thirteen categories were defined prior to abstract selection, and each record was assigned to one or more topics. In Figure 3, the frequency of each topic in the final sample of papers is shown. A great majority of studies concerned alternative production methods and nearly half focused on farmers. Several topics, including Innovation and Agrobiodiversity, were covered only by a small number of papers.

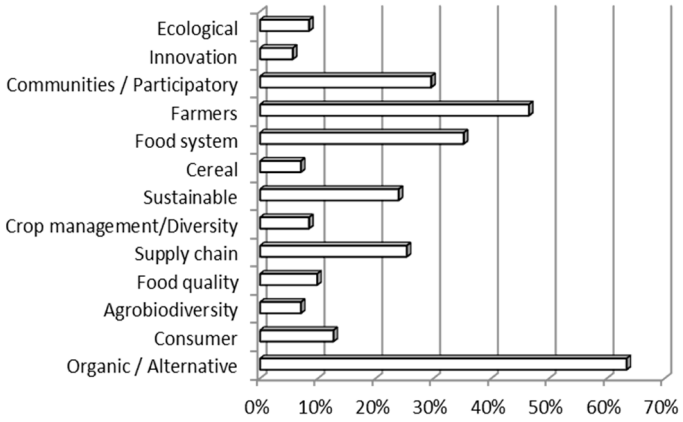

Figure 3. Number of included papers by topic.

As described in the methods section, studies retained after the abstract selection were evaluated using both methodological and relevance criteria. Methodological evaluation followed different rules depending on the nature of the study, i.e., qualitative or quantitative [the evaluation form and rules are described in Section 2.3. Paper filtering process, and in the Appendices B–E]. Qualitative studies represented the large majority of the papers both prior to and following the final selection (66.5% and 76.1%, respectively). However, when comparing the scores received during the evaluation, quantitative papers ranked higher than their qualitative counterpart (average overall scores of 4.03 (s = 0.76) and 3.52 (s = 0.98), respectively).

Relevance evaluation provided more stringent results. The average overall relevance score assigned by reviewers was 3.37 (four out of five statements received an average score lower than 3). Moreover, the presence of a participatory approach and the capability to address practical problems were leading characteristics for pursuing the CERERE project objectives, but they were covered only by 3% and 18% of the studies, respectively.

Finally, the accordance between the results of the two types of evaluation (i.e., methodological and relevance) was assessed through a contingency table (Table 1). The classes used in Table 1 refer to the categorization made to determine the acceptance/rejection of screened papers (see Figure 1). Specifically, for the relevance evaluation Class 1 includes papers with an "Overall relevance" score greater than 3, Class 2 those with a score equal to 3 and Class 3 those with a score smaller than 3. On the other hand, methodological Class 1 coincides with the paths leading (in Figure 1) from the methodological screening to the final acceptance, the other studies being included in Class 2.

Table 1. Contingency table of methodological quality vs. relevance quality.

		Relevance *				
		Class 1	**Class 2**	**Class 3**	**Total**	
Methodological	Class 1	31	12	29	72	Qualitative
	Class 2	10	4	8	22	
	Total	41	16	37	94	
	Class 1	12	2	21	35	Quantitative
	Class 2	2	0	4	6	
	Total	14	2	25	41	
	Class 1	43	14	50	107	Overall
	Class 2	12	4	12	28	
	Total	55	18	62	135	

* The evaluation form and rules are described in Section 2.3. Paper filtering process, and in the Appendices B–E.

4. Content Analysis

The content analysis revealed eight dominant topics (see Figure 4). The themes emerging have been grouped together in sub-themes based on co-occurrences and reciprocity of the subject examined in the papers (Appendix H). The concept map presented in Figure 4 shows the themes and sub-themes on which the content analysis has been carried out. As a consequence, the following sections will report the exploratory findings of topics more discussed and explored within academic literature on "Alternative and sustainable food systems". The themes emerged have been ordered according to a connectedness principle from the most general (AFNs) to the more specific ones ending up with the topic of Sustainability that encompasses them all.

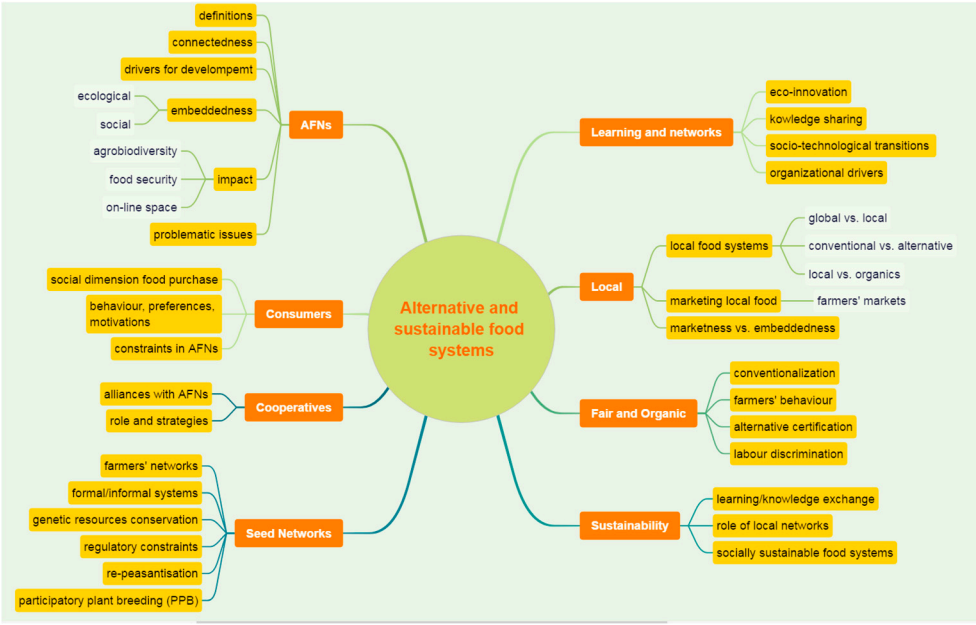

Figure 4. Concept map of topics and sub-topics identified with the content analysis.

4.1. Narrative Description of Themes and Subthemes

4.1.1. Alternative Food Networks (AFNs)

The issue related to AFNs is the most discussed among the present content analysis and it has raised several arguments ranging from *AFNs definition and characteristics*; *connectedness among stakeholders*; *socio-ecological embeddedness*; *impact of AFNs on agrobiodiversity*, *food security*, *online space*; *problematic issues*; and *factors promoting AFNs development*.

In particular, two literature reviews [32,33] highlight that AFN is a broad definition referring to networks that are an alternative to conventional food supply-chains. Examples of AFNs are localized and SFSCs, FMs and CSA [hereinafter, we use terms as Alternative Food Networks—AFNs, Community Support Agriculture—CSA, Short Food Supply-chains—SFSCs, Farmer markets—FM, Civic Agriculture as synonymous, referring to the same class of phenomena.]. Furthermore, both researches point out that a theoretical similarity can be found in the focus of these initiatives that is a stronger relationship between producers and consumers. In a sense, AFNs contribute to the creation of new opportunities for smallholders in rural and peri-urban areas by enhancing their socio-economic position [34] and they encourage a "return of the peasants", that is an ideological space in which farmers and consumers are revisiting together and collectively the core values of the agri-food system. In more details, several types of relations with different levels of *connectedness among stakeholders*, can characterize AFNs worldwide. Some scholars [35–37] state that these relations can range from the face-to-face relationship, in which there is a direct involvement of both producers and

consumers through the direct selling; to the so-called "extended AFNs" in which products are instead sold outside of the region of production. In this perspective, the structure of the FM seems to promote the existence and development of ties through the consumer choice which became a political action linked to the participation to an alternative market [37]. AFNs could have an impact also on the virtual environment of online space [38]: websites and social networks indeed, extend the participation of actors to AFNs providing them with additional opportunities to foster the process of reconnection among each other. It is noteworthy that *food security* could be affected by the positive effects arisen from AFNs: In Sicily (Italy), AFNs have been a driver towards a culture of legality against the socio-cultural phenomenon of mafia [39].

The concept of *embeddedness* has also emerged as a leading theoretical and analytical tool broadly applied to the analysis of the social, territorial and ecological dimensions of AFNs [40]. According to several researches [41–44], the main differences between CSA and other forms of direct agricultural markets lay in the creation of *social embeddedness* within the community and in the consideration of food, land, and nature as linked common goods that need to be preserved. On the other hand, *ecological embeddedness* [45,46] is seen as a means to explain the "ways in which ongoing ecological relations influence economic activity" [45] (p. 325) within AFNs.

The discourse on AFNs is also affected by some criticisms that go beyond the narrative of their benefits. Despite the general perception of AFNs being more socially, economically and environmentally friendly, alternative food chains studies have been criticized because their approach tends to focus on specific sustainability-related issues. The academic literature has criticized the "'romanticizing' the alternative" [47,48] as well as avoiding submitting several reflections typical of the mainstream conventional system to AFNs. In more details, Nost [49], states that the discussion on AFNs articulates around problematic and often contradicting issues involving experiences such as CSA, profit-making, scaling-up, and direct exchange. Furthermore, it has also been pointed out that AFNs neither have consistently positive economic impacts on local food systems nor necessarily encapsulate more sustainable production models or sustainability-oriented motivations by farmers involved [47].

Competition within AFNs [50] and constraints in participating [51] have also been recorded in some experiences of American CSA. In the first case, perceived competition results negatively correlated with CSA farms' profitability, farmers' satisfaction as well as with strong farmers' relationships. In the second case, alternative production methods are said to require longer hours working in the farm. The greater the amount of labour the higher the cost of production, thus this factor impacts negatively on economic viability of this type of enterprise. Differences in the structure of AFN can partially explain the above-mentioned criticisms. If from one hand strong AFNs assure environmental protection and contextually address issues concerning labour standards, animal welfare, enhancement of rural communities, small-scale farmers' rights, and human health, on the other corporate weak AFNs are driven by profit and are often characterized by a long supply-chain [52]. In this view, weak AFNs are located between the strong AFNs and conventional food networks. Finally, some criticism is raised also from the theoretical perspective: Tregear, in the literature review mentioned at the beginning of this paragraph [32], identifies several problems in AFNs research such as: (1) inconsistent use of concepts and terms; (2) conflation of the structural characteristics of food systems with desired outcomes and/or actor behaviours; (3) insufficient acknowledgement of the problems of marketplace trading; and (4) a continued lack of a consumer perspective [32].

In spite of critical aspects, many factors are positively influencing alternative food chain development. These drivers are represented by the growing consumer interest in alternative food products and production methods, the importance of the service sector in emphasizing traceability, the role of rural tourism in fostering demand for this kind of products, urbanization, and rural restructuring [53,54]. Finally, food hubs and auction marts could also have a role in scaling up AFNs, offering greater convenience and affordability to consumers [55].

4.1.2. Consumers

Consumers' issues play a relevant role in the literature on food quality and AFNs. The main topics raised are related to the *social dimension of food purchase* investigated through the concept of embeddedness and connectedness, *consumer behaviour, preferences and motivation*, and some critical issues related to *consumer constraints in AFNs*.

The *social dimension of the food shopping experience* has been investigated by several authors who focus in particular on the social potential of FMs compared to the other shopping outlets [33,56,57]. Besides the utilitarian component of the "rational consumer", who purchases products looking at the best value for money, indeed, a hedonic component exists, linked to personal emotions [56]. This component plays a crucial role within the social exchanges that take place during the purchasing experience. Producer-consumer relationships are indeed based on the degree of connectedness between each other. The strongest ties are usually found where these two groups directly interact [33,57].

Another strand of research is related to *consumer behaviour, preferences and motivation* behind the purchase of alternative food products. Food safety and environmental concerns seem to drive the choice of both organic and local products. Furthermore, the purchase of locally grown products has been associated with an attempt to achieve a better control of food choices within a food system perceived as more and more complex and uncertain, as well as the desire to support a vital local community [58–60]. In other research "sustainability, convenience and consumers' personal gratification are the most significant attitudes that predict the intention to buy in SFSCs" [61] (p. 626). In the US local foods markets, motivated and informed consumers are able to discern between different types of organic certification assigning a price premium of approximately 10% for USDA organic certification but no price premium is associated with competing organic certification program [62].

Finally, problematic issues related to consumers' participation to alternative food markets have been raised [51]. In particular, purchasing at FMs could represent a time-consuming issue since such types of consumption usually require a higher amount of time to be spent in reaching suitable markets, in identifying and buying desired products as well as in cooking them, all time-demanding activities that lead to prefer conventional ways of consumption. Another constraint identified is socio-economic status, in that alternative food products are usually more expensive than conventional ones, and often only middle- and upper-income consumers are able to buy them regularly. The growing supply of organic and local produce of supermarket is a threat to direct marketing and other AFNs. Accessibility, price and higher choice play in favour of conventional retail outlets although contrasted by other considerations (i.e., supporting local business, better quality, reducing food miles,) among more involved customers [60].

4.1.3. Cooperatives

The role of cooperatives in supporting farmers' network has been investigated in a few studies.

Cooperatives support alternative food systems in a range of different contexts playing on the interaction between social spatial and technical domains. In Spain cooperatives, through the development of olive oil networks, are designing new places and new narratives linked to the development of a symbolic capital towards the territorial qualification of the product [40]. Cooperatives also contribute in reducing risks and in providing support for mountain cereal cultivation as in the case of Genossenschaft Gran Alpin [63]. The action of this cooperative, facilitate small cereal producers through a range of activities such as community relationships building, breeding of rare and local varieties, marketing activities, policy advocacy, managing risk. By those strategic actions, the cooperative proves an outstanding role in the promotion of the resilience of marginal systems (at risks to be abandoned with adverse consequences on natural environment) by dealing both with the rapid change of climatic conditions as well as with market prices and policy changes.

The cooperative movement can be seen as a valuable ally of AFNs. In this sense, the combination of these two movements could be of a great value where coops aim at strengthening relations with

local communities, and AFNs aim at scaling up and transforming the food system towards a food democracy, a new food social economy, and environmental sustainability [64].

4.1.4. Seed Networks

The literature on seed networks considered in the present review addresses several issues such as Participatory Plant Breeding (PPB) and its social dimension, genetic resource conservation; formal and informal seed systems, re-peasantisation of agriculture among others.

PPB and participatory variety selection are actively promoted by research institutions with the aim of improving the adoption of new varieties, increasing farmers' knowledge about crops and their evaluation, encouraging their own experimentation and selection and creating business opportunities [65]. With reference to the *social dimension*, PPB is not simply carried out to cope with technical (e.g., finding seeds well adapted to a given agro-environment) or legal constraints (regulation of seed breeding sector), PPB is rather the expression of a social movement with goals that go beyond the economic sphere [8]. In this view, self-production of seeds can increase the autonomy of alternative forms of farming from the agribusiness in line with the agroecological principles that contrast the mainstream patterns of farming [66]. However, according to some scholars, this breeding technique may not be exclusively associated with informal seed system as an alternative to formal seed systems. Several connections may link PPB to formal systems at different levels of the seed chain [10,67], for instance, at the plant breeding phase, where PPB could provide varieties to be refined and released. Moreover, the formal system could also aid PPB varieties to expand their market and gain more visibility. In this sense, commercialising such varieties through the formal system will probably overcome problems related to local seed systems and their weaknesses (small quantities, inequalities, etc.). By contrast, other scholars [9,12] argue that there is a sharp difference between formal and informal seed systems. For instance, the emergence of farmer-based seed networks is constrained by the EU regulations (i.e., EC 2092/91; EC 1452/2003). The standards imposed for the registration and trade of new varieties are based on Distinctiveness, Uniformity and Stability (DUS) and on Value for Cultivation and Use (VCU). Such standards guarantee the conventional quality of the seed production in the seed system but also tend to favour the multiplication of only few varieties that are tested under conventional agricultural practices (e.g., high-input use and homogeneous conditions of cultivation). Conventional varieties are likely to fit poorly with the variability of farming systems typical of small-scale low-input farming and farming systems oriented to agroecology. Furthermore, the limited "legal" space for seed exchange and trade outside the "formal" system, justified by the protection of intellectual property, hampers the development and diffusion of farmer-based variety and their improvements [12]. Intellectual property rights do not currently protect farmers in the development of their own varieties, but instead act as a threat to this practice [68]. Hence, current legislation on property rights should be reinterpreted in order to consider smallholders' needs and, especially, to recognize their outstanding contribution to the maintenance of genetic diversity. Local seed exchange networks are also seen as an essential factor towards *biodiversity and genetic resource conservation*, because they allow "access to seed and the maintenance of landraces in agro–ecosystems throughout the world, despite the trend towards more uniform seed material flowing through formal, commercial seed systems" [10] (pg. 157). In informal seed systems Community Seed Banks, where seeds of several crop varieties are stored and made available to farmers, ensure not only genetic conservation, but also seed security, biodiversity conservation and access to local seed markets [65].

Another key role is played by *farmer networks*, especially in developing countries, in disseminating local and formal varieties, as well as in contributing to agrobiodiversity management, agricultural development and social resilience [23]. Successful seed production groups are "those that are able to produce sufficient seed for group members and also have some in reserve for emergencies" [69] (p. 848). Successful groups feature also other characteristics, such as a clear and efficient decision-making process, an appropriate group size, a transparent group structure, members participating in group activities and meeting regularly, and possessing a good extension support etc. [69].

4.1.5. Learning and Networks

Issues related to *learning* and *networks* are broadly discussed in academic literature on agricultural systems especially with respect to sustainable transitions.

Scholars in the tradition of sustainability studies are often focused on the desirable outcomes of the social learning process, such as the reframing of knowledge, more precisely the creation of a shared frame of knowledge [70]. It has been suggested that networks act at the local level to support resilient food systems and also represent a "politics of possible" in scaling up sustainable approaches to food supply and consumption by creating "networks of networks" [71]. *Knowledge sharing* is proposed as the key factor to develop local networks and connect existing networks. To scale-up the sustainability of food systems, knowledge on practices and experiences should be considered as a common good available to communities which define practices best-suited to their place-based capacities. Similarly, organizations that develop deep knowledge about sustainability can increase their innovative capability, improve their performance and significantly reduce their environmental impact [72]. In a sense, the indirect effects of community learning and participation are strongly linked to sustainability issues and they can enhance local knowledge with "potentially more informed, aware, and empowered consumers and producers" [47] (p. 70). *Organizational drivers* could also serve as strategic factors towards agroecological transition [73] by controlling the distribution of costs and benefits of innovation along the supply-chain, reducing opportunistic behaviours and creating proper incentives in all the components of the system. Other scholars [74] have presented ecological entrepreneurship as a process where key actors promote sustainable agricultural development through a combined strategy of specialization, fragmentation and quality building. The commitment of those key actors towards cultural and ecological preservation along with their attention towards environmental integrity is crucial for the establishment of economic benefits (e.g., employment) in the local community.

In a broader perspective, niche markets developing within the dominant socio-technical regime can help and protect the exploitation of radical innovations, working as incubators of *socio-technological transitions* [75]. Outside the niches the Increasing Return to Adoption (IRA) model shows that the more a technology is adopted the more its performance improves, and other complementary technologies develop in conjunction. The factors underlying IRA are economies of scale, learning-by-doing, and network externalities, thus the development of alternative technologies is initially confined within niches. This framework has been applied to study the (missed) development of cover crops in France under the common Agricultural Policy [76].

4.1.6. Local

The local dimension is a key one in characterizing food systems. Some scholars have broadly pointed out that *local food systems* (either based on organic production or not) are a suitable alternative towards a more sustainable and fair food system [77,78]. Other scholars have underlined that the polarization between the *global* vs. *local* is related to opposites of *conventional* vs. *alternative* and *local* vs. *organic* [79,80].

Three possible domains have been suggested to define the local dimension:

- geographical domain, where local refers to spatial proximity;
- relational domain, where the chain actors engage themselves in a complex network of relationship;
- "values of proximity" domain, that includes all the positive values people usually associates to local food (e.g., environmental sustainability, social justice, eating seasonally etc.)

An interesting perspective is represented by the comparison of Mediterranean and Anglo-Saxon (UK and USA) strategies to promote territorially based initiatives [77]. Mediterranean actors usually promote local products through legislation-recognised methods and labels such as Geographical Indications (PGI, PDO etc.). In this context, the "local" is represented by a number of environmental, historical and heritage characteristics firmly bound to both the territory and the population. Conversely,

US and UK initiatives are more related to the concept of AFNs, where locality is usually defined in term of geographical distance and more attention is given to supply-chain relations, especially between producers and consumers. According to some scholars [79] local food networks appear to be more sustainable food provision systems thanks to their higher degree of relations based on trust and social embeddedness. Nevertheless, alternative and/or local food networks are not homogeneous entities, but rather amorphous systems. Producers are not part of either the global or the local food system, but of both. Thus, the commonly constituted binary of the "local" and the "global" is problematic. Indeed, both "global" and "local" are linked together in an overall food system [79,80].

Other analysts underline the limitations as well as the strengths of localizing food production as a sustainability strategy by comparing, at different scales, the environmental impacts and resource use of bread and flour production [81]. According to this study "bread production in local bakeries requires more total energy input per kg of bread than the industrial bakery, mainly due to inefficient technology" [81] (p. 217). However, GHG emissions are smaller in the case of bread produced in small local bakeries than from big ones due to the fact that the transportation routes are much shorter for bread from the small bakeries.

The *marketing of local food* is also a prominent issue. In the UK, supermarkets have begun offering organic products and marketing their own local produce ranges, showing a quick response to the increasing demand for local and organic products [60]. In the modern food system, indeed, we are witnessing a phenomenon of polarization (industrialized production, hypermarkets, economies of quantity from one side and from the other small businesses linked to alternative food markets and SFSCs) which is mirrored in the retail sector [82]. The increasing concentration of food retail companies is contrasted by the emergence of direct sales that leave room for alternative enterprises. SFSCs and AFNs are shaping a new geography of food, which has a correspondence in new retail geography. In this framework, the motivations for retailing local products range from the willingness to meet local demand, to matching lifestyle changes, to company diversification strategies. The retailing sector is also affected by some problematic issues such as access to and availability of local products both linked to seasonality and to the limited quantities of products supplied by small local enterprises. However, there is very little empirical data to quantify the importance of direct sales and AFNs in terms of sales value [82]. Finally, in line with a more critical view [41], although FMs are defined as the quintessential local delivery systems, the component of embeddedness seems significantly permeated by both instrumentalism and "marketness". Many farmers take part in FMs not only to get a premium over wholesale prices, but also to benefit from the market experience as a social event. Actually, "marketness" and instrumentalism orient the actions and interests of both producers and consumers, whatever the embeddedness of particular FMs.

4.1.7. Fair and Organic

Organic agriculture (OA) is mainly discussed focusing on issues such as organic farmers' behaviour and marketing strategies; alternative certification models for fair and organic products, conventionalization of OA and labour discrimination.

A number of studies have investigated *organic farmers' behaviour and their marketing strategies*. Researchers attempted to evaluate in particular the styles of behaviour among organic producers, the differences and similarities regarding their ideas about how alternative agriculture has an impact on the environment and on society, as well as the motivations for practicing organic farming [78,83,84]. Income diversification, selling ecological products, and supporting the local community represent the main motivations for organic producers for joining together in the case of a cooperative [63]. Among the marketing strategies *quality differentiation* (in the form of the promotion of organic production, marketing of processed cereal-based food with strong linkages with the territory) represents the main driver in supporting cereal production in marginal areas [63].

Another prominent issue refers to *alternative certification models* [it is worth underlining that under the current European Regulation on organic agriculture ((EC) No 834/2007) no alternative

guarantee systems are allowed than third-party certification, while the new Regulation ((EC) No 848/2018) will also include group certification.] for guarantee the authenticity of eco-friendly, fair and organic productions. Previous studies have explored the role of local and or public initiatives in supporting small-scale producers to access new markets. The need of such initiatives is based on the fact that private third-party certifications (TPCs) are considered to be too expensive for such farmers [85]. Zanasi et al. [86] find in the Participatory Guarantee Systems (PGS) an outstanding community development instrument. PGS guarantee the authenticity of local organic productions and are in between totally informal guarantee systems and a more formal third-party certification system. They imply participation and joint responsibilities of all stakeholders in guaranteeing the quality of the product. Furthermore, they are usually embedded in vital communities and foster cohesion and trust among members of those communities [86]. Finally, PGS scheme has been a crucial driver in increasing the participation in Mexican AFN, both by producers and consumers' side [34]. Generally speaking, Mexican PGS scheme is aimed at promoting, rather than regulating, a community based on agroecological principles.

A controversial aspect linked to OA is represented by the current conventionalization of the organic productive paradigm mainly within the new world. The current US organic food system, indeed, has been criticized in particular regarding the substantial increase of organic products into the markets that would question the true nature of the organic movement. In this sense, some authors claim the need for undertaking a debate to address the increasing concerns about the actual "alternativeness" of the organic system [58]. The authors propose a clear distinction between organic and local food stating that organic food became the expression of productive standards failing "some of the social and economic ideals, such as production occurring via an environmentally friendly system of small- and medium-scale independent producers serving local markets" [58] (p. 244). In this sense, the agribusiness model has been able to affect organic production in defining rules and agronomic practices. Currently, powerful US buyer firms seems to dominate the organic sector in contrast to the vision of a multitude of small independent farms [87]. The same problems are faced in country such as Brazil where initially the development of organic agriculture has been fostered by the marginalisation of the area and the profitability lost by farmers [88]. OA was suggested by internal actors but then, because of the emergence of a strong intermediary organisation and of the arrival of big retailers, it was developed in a "conventionalised" way, simply replacing conventional inputs with "organic" ones. In relation to the theme of conventionalisation of OA, critical aspects of social justice and marginalization were raised regarding labour model strategies. In some cases [89], indeed, the most important sources of labour are migrant workers, apprentices and women. The analysis of the working conditions of migrants and apprentices highlights the presence of discrimination as well as of marginalisation.

As far as the organic seed sector is concerned, the GRAIN Briefing 2008 [90] stated that "organic seeds are clearly not immune to the corporate consolidation sweeping the organic industry and the larger food system. Indeed, some of the bigger seed corporations have already started developing and supplying organic seeds". In this framework, Desclaux and Nolot [91] propose four factors to represent organic seeds variety requirements: (1) label, (2) brand, (3) autonomy and (4) empowerment. The label is coherent with the current EU regulation on organic farming, characterised by a strict adherence to guidelines and a collective governance of the system (regulation and standards, third party certification), while the brand adheres to guidelines in an individual logic, as in the case of the contract cultivation of varieties produced and owned by food industries; autonomy attempts to design a new system considering farming process as a whole, including both environmental and social aspects of production; and finally, in the empowerment the design of a new systems is pursued as a collective action.

4.1.8. Sustainability

In general terms, all the papers analysed in this review intersect the *Sustainability* issue, but some of them specifically focus on this topic considering aspects such as the *socially sustainable food system*, *SMEs supply-chains sustainability*, the *role of local networks* towards sustainability, as well as the *learning and knowledge exchange*.

A *Socially sustainable food system* is described as the one that does not disintegrate in the face of changing conditions, being rather resilient and adaptable to variations in consumption patterns, population size and climate change [92]. In this sense, social sustainability of food systems should consider four main elements: social justice and equity; social infrastructure; social capital and engaged governance, which represent "a way of working together within a community" [93] (p. 1127). In this view, FMs are socially sustainable due to the shared appreciation of the food, the social justice and the equity perspective. DaVià [12], in her contribution already mentioned, analyses the *role of local networks*, a form of social capital, towards sustainability. The author discusses the role of local seed networks in the transition to sustainability in the agri-food system in Europe by arguing that peasant innovation is a fundamental driver of transition. Re-peasantization, in particular, represents a political movement to enhance the sustainability and resilience of rural systems in the EU. This new peasantry struggles not only for the reproduction of farming activities but also for the resilience of rural economies challenged by an increasing dependency on industrial and financial capital. The practices and the strategies included under the umbrella of the re-peasantization aim at the creation and the development of a self-controlled resource base on which local farming systems and rural economies can survive and develop in autonomy.

Moving from the system to the firm scale, *SMEs sustainability* is analysed along the supply-chain by using food sustainability criteria developed by SUSTAIN (the Alliance for better food and farming) [93]. As results, local firms show mixed sustainability performance especially in relation to proximity (minimization of energy use), accessibility and social inclusion. However, it is argued that it is difficult to correctly value the sustainability of food chains using SUSTAIN criteria, which are considered somewhat "arbitrary and conflicting".

5. Policy Implications

The social aspects related to the transition towards a sustainable model of agriculture, widely discussed in this review (consumer-producer connectedness, re-peasantization, social embeddedness, knowledge co-production and social learning, to cite a few) have profound implications for rural development policies in the EU. Of the 6 common EU priorities of the 2014–2020 policy framework of the EU rural development policy (CAP 2nd pillar) at least two are directly of concern; P1 "fostering knowledge transfer and innovation in agriculture, forestry and rural areas" and P5 "restoring, preserving and enhancing ecosystems related to agriculture and forestry" (Regulation (EU) No 1305/2013).

The major contributions of the literature papers chosen by CERERE farmer networks can be organised around the concept of agri-environmental public goods. Public goods can be defined according to two approaches; economic, and socio-political. Within the first approach, public goods are defined on the basis of technical characteristics of non-excludability and non-rivalry in consumption. Such characteristics imply that the market cannot provide the good at the socially optimum level, as the producer cannot appropriate the outcomes of her productive efforts. According to the socio-political approach public goods are defined as "what is good for people and what people want for their collective well-being" [94] (p. 6). Examples of public goods covered by both approaches and provided by agriculture are soil functionality, agrobiodiversity, health and wellbeing, rural vitality [94].

According to Vanni [95] the two concepts of public goods in the agri-environmental context lead to different policy approaches to promote their provision. The economic approach relies on traditional policies based on instruments such as regulation or incentives to single farmers. Within the EU CAP these instruments are currently implemented in the cross compliance and the greening measures under the first pillar, and in the agri-environmental measures under the second pillar, notably addressing the

above mentioned 5th priority. Conversely, the socio-political approach inspires a richer set of policy instruments extending beyond incentives and regulation and aimed at promoting the socio-political processes underpinning the collective effort for the provision of public goods. Indeed, in this tradition the goods are often provided through a collective action whereby a number of subjects co-operate to produce the good. Examples of the additional policy instruments needed to facilitate these processes are public-private partnerships, institutional capacity building, support to inclusive decision making, rural animation, public food procurement and the like [95]. The EU Leader initiative is an example of bottom up policy measure in line with the socio-political approach. Another example are the rural development measures fostering knowledge transfer and innovation in agriculture, forestry and rural areas under the umbrella of the agricultural European Innovation Partnership (EIP-Agri).

Notably, the second model for public good provisions in rural areas is consistent with the policy developments outlined by Renting and Wiskerke [96]. According to these authors the key mechanism of governance of the agri-food system in Europe are the Market, the State and the Civil Society. The starting of the CAP in the 1960s was characterized by public regulations of markets and infrastructural conditions aimed at modernizing the sector (Market and State). Subsequently, the CAP crisis (budget, overproduction, environmental impacts) led to a shift; away from market and price instruments to moving to supporting production followed by environmental performance. Currently, we are entering in a new governance mode where many new societal issues (such as health problems and wellbeing, environmental pollution and ecological degradation, loss of food diversity, pressures on farm and rural income) are addressed combining all three key mechanisms of governance. Active citizen involvement (Civil society mechanism) has an important role, while the State is present at a smaller territorial level such as regions or even municipalities.

Most of the AFNs studies reviewed in this paper remain at the intersection of market and civil societies, to produce public goods such as healthy food and wellbeing while promoting rural vitality. Paradigmatic is the work by Migliore et al. [42] on the reinterpretation of the Sicilian mindset as a result of the work of an alternative food network. Social embeddedness is another strand of the literature that complements literature on alternative food networks. However, some weaknesses are also highlighted, including a lack of social inclusiveness and sustainability in cases of defensive localism whereby the alternative food network serves the needs of elitist and wealthier consumers rather than the local community [77,80].

Perhaps more interesting are the implications for the production of some environmental public goods such as soil functionality and agrobiodiversity. The studies on the role of peasantry for the promotion of an agro–ecological model, and the literature on social learning [47,70–72] and seed networks for the conservation and management of agrobiodiversity [8,9,12], both support a model according to which public goods are the results of collective action. A distinctive characteristic of these networks is the co-production and sharing of the information needed to address the challenges and bottlenecks that producers face when shifting from a conventional to an agro–ecological model of agriculture [73]. As stated by Pretty [5] in the agroecological model "technologies and practices must be locally adapted and fitted into place." The related innovations are more likely to be implemented in the presence of a high level of social capital and human assets "comprising relations of trust embodied in new social organisations, new horizontal and vertical partnerships between institutions" as well as "leadership, ingenuity, management skills and capacity to innovate".

Although few studies [45,46] acknowledge some positive impact of agri-environmental schemes on the development of alternative food networks, most of the literature reviewed highlights an imperfect alignment between the policies currently in place and what would be necessary to support more sustainable agriculture through a territorially integrated approach.

Rather than focusing on policy instruments like the current agri-environmental schemes, which attempt to modify crop and land management at single farm level, it would be advisable to rely more on instruments aimed at facilitating territorial processes involving groups or networks of actors. Notably, the role of facilitators and rural "animators" in the tradition of the Leader initiative should

be enhanced in order to create the spaces where local actors can meet, and inclusive decision-making processes can take place. Institutional capacity building is another key instrument that could be implemented to encourage the role of local institutions (such as municipalities) in the new governance of agri-food systems [95,96]. For example, local civil servants could be trained in order to develop public food procurement initiatives aimed at supporting local and organic produce [97].

6. Discussion and Conclusions

The participatory approach is the main innovation and distinctive approach of this literature review. On the one hand, this is a strength as the literature selected intends to deal with issues relevant to the stakeholders involved. The review may be considered a starting point for integrating research results and good practices to foster current and future sustainable practices in the cereal systems. On the other hand, the coverage of themes and papers mirror the specific interests, value systems and points of view of the consortium participants, in particular of the three main farmer networks. As a result, the coverage of papers reflects issues relevant to project partners' field activities. Also, the topics covered are quite varied, although all of them may be broadly gathered under the umbrella of alternative food systems. Overall, the approach used, and the adoption of given selection criteria assure transparency of the whole process. As seen, most papers cover both positive and negative elements of AFNs and impacts of the issues facing them. The positive discourse concentrates on three main areas: *connectedness/embeddedness* among producers and consumers [32,35–37]; *re-peasantization* in which a new narrative of food sovereignty against the mainstream industrialized food provision is established [34]; and the role of *engagement of civil society* in civic agriculture movements working towards political and social activism [39]. The negative issues recorded are mainly related to the "danger of 'romanticizing' the alternative" [47,48,50], as well as to constraints in accessing alternative food products for consumers and the difficulties for producers in engaging in AFNs [51].

Another prominent topic emerged from the literature review regarding the organic agriculture paradigm (itself an alternative food system). In this case, some research focus on the differentiation between strategies of organic production [63] but, most notably, a strong criticism is related to the *conventionalization* of the organic production model. According to the authors included in this review, organic agriculture has indeed lost his distinction of "alternativeness" in switching from its original social and economic ideals linked to fairness and environmental protection, towards a focus on production standards [58,87,88,90]. In the same logic, organic certification is seen as financially out of reach for many smallholders [85]. Alternative certification strategies such as Participatory Guarantee Systems play an important role as a community development instruments in other parts of the world [86] and are identified as a crucial factor in the development and increasing participation in many AFNs in Europe [39]. *Locality* may hold the potential for overcoming the issue of *conventionalization* of organic paradigm. Many scholars refer to spatial proximity among producers and consumers as a factor for building a more sustainable food provision system, due to the role of strong ties among community members based on trust and social embeddedness [12,41,79,80,82]. This evidence is confirmed by the current trend of supermarkets of marketing local products as quality goods [60]. The role of consumers in building AFNs has been investigated through the concept of connectedness and embeddedness, but also in relation to their behaviour, preference, and motivation in purchasing alternative products. Besides the utilitarian reason for purchasing healthy food, it emerges that a strong concern for the environment influences consumer choice to buy locally grown food and have more control over their choice of food provenance and quality [58,59] but also reasons for not taking part in AFNs were highlighted, such as lack of convenience and cooking skills [51].

Finally, papers focused on seed networks differ mainly on their geographical localization; the polarity in this case is between research based in less developed versus more developed countries. In the first case, it shows the need for evolving from seed networks towards local seed businesses [67], while in the second case it highlights issues related to formal/informal seed systems [12,67] as well as the standardization of the supply-chain and the need for genetic resource conservation [10].

To sum up, far from presenting an overly optimistic (and potentially biased) view of alternative and diversity-based agricultural systems, the review offers an analysis of both strengths and weaknesses of these systems providing a fruitful starting point for future analysis which integrates research results and good practices to foster current and future sustainable practices in the food systems.

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Appendix A. Keywords and Sub-Keywords Selection

Rural Development			
Supply-chain Management	*Community*	*Network*	*Innovation*
Alternative food supply-chain	Commons	Bottom-up initiatives	Innovation systems
Average wages/salary	Community empowerment	Collaboration	Niche management
Bakery	Farmer/Producer mental health	Collective action	Public food procurement
Consumer	Farmers' empowerment	Collective organisation	○
Direct marketing	Grassroots forms	Cooperation	○
Distribution	Identity	Farmers' clubs/networks/associations/groups	○
Employment generation	Job security	Local level food chains	○
Employment quality	Local history and heritage	Network analysis	○
Entrepreneurship	Open source seeds	Social differentiation	○
Equality	Participatory approaches	Trust	○
Equity	Rebuild communities	○	○
Fair value chain	Reconnection	○	○
Farmers' markets	Re-settlement	○	○
Food labelling	Seeds property and social organization	○	○
Governance	Shared enterprise	○	○
Intellectual property rights effect	Teamwork	○	○
Labour requirement	Wellness	○	○
Labour shortages	○	○	○
Livelihood	○	○	○
Local food	○	○	○
Long-term employment	○	○	○

	Rural Development		
Supply-chain Management	*Community*	*Network*	*Innovation*
Market orientation of SMEs	○	○	○
Marketing	○	○	○
Microenterprises	○	○	○
Organic	○	○	○
Ownership	○	○	○
Price construction in artisanal chains	○	○	○
Prices in small scale production	○	○	○
Regulation	○	○	○
Relations to political context	○	○	○
Risk	○	○	○
Seed regulation	○	○	○
Supply-chain growth/expansion	○	○	○
Sustainability	○	○	○
Trade negotiations	○	○	○
Value added	○	○	○
Vicinity food	○	○	○

Appendix B. Eligibility Screening

Study ID			Paper_1	Paper_2	Paper_3	Paper_n
Questions	Is the study written in English, French or Spanish?	*YES* *NO*				
	Are the areas interested by the study located in developed countries?	*YES* *NO*				
	Has been the study published after 2000?	*YES* *NO*				
Type of the study	Published article Abstract/Presentation Book/Book chapter Technical/progress report Working paper Unpublished dissertation Other (specify):					
Focus area of interest of the study	Agronomy and Technical aspects Nutrition and Health Alternative/Sustainable food networks					
Quantitative or a qualitative study	Quantitative Qualitative					

Appendix C. Methodological Screening: Qualitative

Study ID		Paper_1	Paper_2	Paper_3	Paper_n
Data collection method	Questionnaire Secondary analysis Interviews and/or focus groups Literature review Other (specify)				
Research strategy	Survey Single case study Multiple case study Theoretical Literature study Other (specify)				
Participatory approach	*YES* *NO*				
Statements (Assign to each a score from 1-*strongly disagree*- to 5-*strongly agree*)	The study's objectives are clearly stated The sample size is large enough and enough variety is present in respect to the most important variables (gender, farmers, retailers, consumers) The data collection method is clearly defined The method used in analysing data is thoroughly explained				

Additional notes (and any additional comment that you deem necessary to assess the study, for example about the soundness of the theoretical references of the study).

Appendix D. Methodological Screening: Quantitative

Study ID			Paper_1	Paper_2	Paper_3	Paper_n
	Type of the study	Experimental study Observational study Review				
Questions	Are the study objectives and research questions clearly stated?	*YES* *NO*				
	Are hypothesis thoroughly defined?	*YES* *NO*				
	Which is the experimental design of the study (if applicable)?					
	Is the sample large enough according to the study objectives?	*YES* *NO*				
	Has the sample the proper composition (gender, age . . .) according to the study objectives?	*YES* *NO*				
Statements (Assign to each a score from 1-*strongly disagree*- to 5-*strongly agree*)	The data collection method is exhaustively explained The data collection method is reliable (no measurement errors) The method offers valid measures (they assess what it purports to measure) The variables are clearly defined The analytic/statistical method used is consistent with the study objectives Results answer to all study questions Study's conclusion comes directly from the data collected by the study					

Additional notes (and any additional comment that you deem necessary to assess the study, for example about the soundness of the theoretical references of the study).

Appendix E. Relevance Screening

Study ID			Paper_1	Paper_2	Paper_3	Paper_n
Scope of the study	Traditional food staff New healthy products Farming Processing Consumption Other (specify):					
Questions	Is the study addressing practical problems?	*YES* *NO*				
	Is a participatory approach in place?	*YES* *NO*				
Practical implications	Ways of including diversity at farm level Processing these diverse raw materials Human health Supply-chain management Creating new markets for these products Other (specify):					
Overall relevance of the study	Overall relevance Why?					
Case studies relation	Case studies to be coupled with the study Why?					

Appendix F. Inter-Coder-Reliability Process

The participatory nature of the review implies that several reviewers take part in the process, leading to potentially different results in terms of papers' evaluation. To take account of this, we devised some procedures to check for accordance between reviewers both during the screening process and the content analysis.

The evaluation of accordance between reviewers during the screening process consisted in selecting a random sample of papers and assigning each paper in the sample to two reviewers. The reviewers filled the methodological/relevance form according to the rules described in the methodological section. Before giving the form to reviewers, we decided which of the two evaluations to use in the screening process, while we used the other for assessing the degree of accordance. Reviewers did not know which of the forms was selected for the use in the screening process and which one for assessing accordance.

Once reviewers filled the evaluation forms, we measured the degree of discordance between the two reviewers for each paper, comparing the results for the "Statements" section of the methodological form and for the "Overall relevance" section of the relevance form, the two sections most relevant for the selection (see Section 2.3 in the main text). For the methodological form, we computed, for each statement, the difference (in absolute values) between the scores assigned by the two reviewers. The differences in single statements were then averaged to obtain a unique "discordance value" for the paper, which was then standardized to a 0–1 scale. Averaging these values across all papers used for measuring the degree of accordance, we obtained an overall discordance value, which was then translated in the final degree of accordance (degree of accordance = 1 − discordance value). The same procedure was used for assessing accordance in the relevance screening. However, while the "Statements" section of the methodological form contains 4 scores (1 for each statement), the "Overall relevance" section is assessed through a single score. Therefore, the normalized difference in this score between the reviewers constitutes itself the paper's "discordance value", with no need to compute average values. Table A1 shows the share of papers used in the assessment of the degree of accordance, and presents the results for both the methodological (qualitative and quantitative) and relevance evaluation.

Table A1. Inter-coder-reliability: evaluation of accordance of the methodological and the relevance screening.

Type of Evaluation	Number of Papers	%of Checked Papers *	Average Discordance Value (Statements)	Accordance (Statements)	Average Discordance Value (Overall Relevance)	Accordance (Overall Relevance)
Methodological (qualitative)	41	42.7%	25.8%	74.2%	-	-
Methodological (quantitative)	19	44.2%	26.2%	73.8%	-	-
Relevance	61	43.6%	-	-	43.4%	56.6%

* % of checked papers are computed on the total number of evaluated papers of the same type (qualitative/quantitative).

For measuring the accordance score in the content analysis process, a random sample of 36 papers were assigned to two different reviewers to perform a "quality" check, similar to that performed for the screening process. Participants were initially left free to codify the content of the papers with 2 or 3 own codes. Afterwards, semantically similar codes were grouped and the analysis of accordance was performed on these grouped codes, counting the share of identical codes for each paper over the total number of codes proposed for the article by the two reviewers. Percentage classes of accordance was created based on quintiles of the distribution. Averaging the papers' accordance scores we obtained an overall accordance score between reviewers equal to 60%.

Table A2. Inter-coder-reliability: evaluation of accordance of the content analysis process.

Themes	% of Checked Papers	Accordance Score
AFNs	32%	0.80
Consumers	33%	0.93
Cooperatives	33%	0.50
Fair and organic	62%	0.63
Learning and networks	50%	0.40
Local	60%	0.53
Seed networks	55%	0.60
Sustainability	57%	0.41
mean		0.60

Appendix G. Example of the Final Structure of the Text Form Arisen from the Content Analysis

Title: Virtual reconnection: The online spaces of alternative food networks in England
Authors: Bos, E., Owen, L.
ID: Bos20161

Topic 1: *Alternative Food Networks*
Description
Drawing on a range of eight AFN case studies in England and using a multi-method approach, the study explores the notion of reconnection within online space to show how social relations have changed, and are changing as a result of online activity.

Topic 2: *On-Line sales*
Description
The study found that the embodied, socio-material reconnection processes that occur in-place also occur online. However, by extending AFN spaces, virtual reconnection cannot fully replicate the same embodied and tactile experiences associated with the material spaces of AFNs. As such, online spaces in the context of AFNs provide a useful additional realm for reconnection, but need to be understood as supplementary rather than as a substitution for socio-material reconnections.

Topic 3: *Reconnection*
Description
Reconnection has been used within the context of AFNs, civic agriculture and local food systems as a critical process through which embeddedness and arguments about sustainability gravitate.

Appendix H. Papers Grouped within the Topics Arisen from the Content Analysis

Themes	References
Alternative Food Networks (AFNs)	Bos and Owen, 2016 [38] Bruce and Castellano, 2016 [51] Chiffoleau, 2009 [37] Follett, 2009 [52] Forssell and Lankoski, 2015 [47] Galt et al., 2016 [50] Higgins et al., 2008 [35] Hinrichs, 2000 [41] Ilbery et al., 2004 [53] Jarosz, 2008 [54] Johnson et al., 2016 [55] Milani Marin and Russo, 2016 [39] Mincyte and Dobernig, 2016 [48] Migliore et al., 2014 [42] Moragues-Faus and Sonnino, 2012 [40] Morris and Kirwan, 2011a [45] Morris and Kirwan, 2011b [46] Nigh and González Cabañas, 2015 [34] Nost, 2014 [49] Obach and Tobin, 2014 [43] Renting et al., 2003 [36] Tregear, 2011 [32] Venn et al., 2006 [33]

Themes	References
Consumers	Bean and Sharp, 2011 [58] Bruce and Castellano, 2016 [51] Cicatiello et al., 2014 [56] Connolly and Klaiber, 2012 [62] Giampietri et al., 2016 [61] Hunt, 2007 [57] Seyfang. 2006 [60] Smithers et al., 2008 [59] Venn et al., 2006 [33]
Cooperatives	Bardsley and Bardsley, 2014 [63] Fonte and Cucco, 2017 [64] Moragues-Faus and Sonnino, 2012 [40]
Fair and Organic	Bardsley and Bardsley, 2014 [63] Bean and Sharp, 2011 [58] Blanc, 2009 [88] Clark and Martinez, 2016 [85] Desclaux and Nolot, 2014 [91] GRAIN Briefing 2008 [90] Guthman, 2004 [97] Nigh and González Cabañas, 2015 [34] Pinna, 2017 [83] Sage and Goldberger, 2012 [84] Schäfer et al., 2009 [78] Trauger, 2007 [89] Zanasi et al., 2009 [86]
Learning and networks	Fares et al., 2012 [73] Magrini et al., 2016 [76] Marsden and Smith, 2005 [74] Zanasi et al., 2009 [86]
Local	Bowen and Mutersbaugh, 2014 [77] Da Và, 2012 [12] Hinrichs, 2000 [41] Hinrichs, 2003 [80] Ilbery et al., 2004 [53] Ilbery and Maye, 2006 [82] Milani Marin and Russo, 2016 [39] Milestad et al., 2010 [79] Nost, 2014 [49] Renting et al., 2003 [36] Schäfer at al., 2009 [78] Seyfang. 2006 [60] Sundkvist et al., 2001 [81] Tregear, 2011 [32]
Seed Networks	Alemu, 2012 [65] Bishaw and Turner, 2008 [67] Chable, 2014 [8] Coomes et al., 2015 [23] DaVià, 2012 [12] Desclaux et al., 2008 [9] Lopes et al., 2015 [69] Pautasso et al., 2013 [10] Salazar et al., 2007 [68]

Themes	References
Sustainability	Blay-Palmer et al., 2016 [71] Da Via, 2012 [12] Forssell and Lankoski, 2015 [47] Ilbery and Maye, 2005 [93] O'Kane and Wijaya, 2015 [92] Pogutz and Winn, 2016 [72]

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